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# Conserve O Gram

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## Caring For Cellulose Nitrate Film

### *What Is Cellulose Nitrate Film?*

Cellulose nitrate (nitrate) refers to a family of transparent, light, flexible, and easy to handle film supports used for motion picture film and still photographic negatives. This material was most common between about 1910-1950. Nitrate can hold a black-and-white negative or positive still photographic image. It was also used as the base for black-and-white or color motion picture film negative or positive images. Paper-based photographs are **never** nitrate. If deteriorated, nitrate may be yellowed, tan colored, stained, bleached, sticky, brittle, blistered, pungent-smelling, or powdery, depending upon the stage of deterioration. Specific tests, described in *Museum Handbook*, Part I, Appendix R: Curatorial Care of Photographic Collections, have been developed to identify nitrate. During the 20<sup>th</sup> century, amateur and professional photographers used cellulose nitrate more frequently than any other film support to hold the emulsions of their negative and film images.

### *The Problems of Nitrate*

Unless stored at a very low temperature, cellulose nitrate motion picture and still photographic film (also known as nitrate) self-destructs at an unpredictable rate over time. As it deteriorates, nitrate gives off acidic by-products (nitric oxide, nitrogen dioxide). These acidic gases are deep lung irritants. Repeated exposure may cause eye irritation, rashes and sores on the face and skin, vertigo, nausea, headaches, swollen glands, and

respiratory irritation. By-products from nitrate film also damage surrounding museum materials causing embrittlement of paper and film and cumulative damage to many organic materials and metals. Deteriorated nitrate film is highly flammable and can burn under water. Once ignited, nitrate fires are almost impossible to put out. The toxic gases produced by burning nitrate are lethal. Nitrate should **not** be stored in general museum, archival, or office spaces.

***Most collections of motion picture and still negative materials dating from 1910-1950 contain nitrate.*** Recent surveys of park photographic collections have shown that parks have significant holdings of nitrate motion picture and photo negatives. The primary method of preserving nitrate is to duplicate the original material onto safety film before it reaches deterioration stage 3 (see below). For guidance on how to do this see *Conserve O Gram* leaflets 19/10-19/13, which explain how to prioritize materials for reformatting, select a copy technology, contract for reformatting, and inspect the resulting duplicates. See the *Museum Handbook*, Part I, Appendix M: Curatorial Care of Cellulose Nitrate Film, for guidance on identifying, duplicating, and managing these collections. This *Conserve O Gram* provides summary guidance on how to house, handle, package, and ship nitrate materials for duplication safely and effectively while minimizing the health risks inherent in these collections.

To Care for Your Nitrate Do This...	Don't Do This...
<p><b><i>Housing/Storage of Nitrate Negatives, Transparencies, Motion Picture Film, X-Ray film, and Microfilm</i></b></p> <ul style="list-style-type: none"> <li>• Store nitrate in cold dark storage in a vault or frost-free freezer at &lt;40° F (&lt;4.4 ° C), 20-30% RH. For every 10° F rise in temperature, the deterioration rate doubles.</li> <li>• Isolate nitrate from other items as it gives off damaging acidic gases and warn your fire department about the nitrate.</li> <li>• Replace nitrate negatives and film in general storage with acid-free separation sheets that indicate their new location.</li> <li>• Rehouse negatives in new <b>buffered</b> paper four-flap envelopes or L-weld sleeves that meet ANSI IT9.2 specifications; then place within an archival box in a Ziplock® bag in a frost-free freezer. Put a humidity indicator label inside the bag. Place nitrate film in perforated film cans to allow gases to escape.</li> <li>• Transfer all old information to the new housing.</li> <li>• Program for duplication funds immediately.</li> </ul>	<ul style="list-style-type: none"> <li>• Don't allow smoking, an open flame, or high heat near nitrate.</li> <li>• Don't house nitrate freezers in your museum storage area, as cold storage doesn't eliminate all fume buildup.</li> <li>• Don't dispose of undeteriorated nitrate until interpositives are produced that pass inspection. See <i>Conserve O Gram</i> 19/13.</li> <li>• Don't keep nitrate negatives with a flowing or powdery image surface. Dispose of them as hazardous material after deaccessioning.</li> <li>• Don't dispose of nitrate in the trash.</li> <li>• Don't house nitrate in plastic.</li> </ul>
<p><b><i>Setting Up Your Nitrate Work Space</i></b></p> <ul style="list-style-type: none"> <li>• Set up a work area in a cool, well-ventilated space far from office areas and collections.</li> <li>• Gather necessary equipment, supplies, and tools before you begin, including goggles; a specially-fitted, rated breathing apparatus for each worker; vinyl or latex gloves; rolls of unprinted newsprint; washable smocks; and work tables and chairs.</li> <li>• If workspace ventilation is not good, obtain a large fan and position it so that the airflow blows directly past you to push fumes away.</li> </ul>	<ul style="list-style-type: none"> <li>• Don't neglect to wash your work surface daily with a solution of 1 teaspoon baking soda to one pint of water to neutralize the acid build-up from the nitrate.</li> <li>• Don't ever work with nitrate in a hot, stuffy room or near any source of sparks or high temperature.</li> <li>• Don't let your cold-storage nitrate get disorganized. Browsing through the freezer to look for items can shorten the film life.</li> </ul>
<p><b><i>Working with Nitrate</i></b></p> <ul style="list-style-type: none"> <li>• Maintain a log of who works with nitrate and when. Document any problems in the space, including odors, discomfort, or ill effects.</li> <li>• Work on a surface that is easily washable or use layers of clean non-printed newsprint paper, which can be ripped off and disposed of at the end of the day.</li> <li>• Wear vinyl or latex gloves and a long-sleeved washable smock as protection when working with nitrate.</li> <li>• If you notice any odor or experience irritation, also wear a fitted, rated breathing apparatus and goggles.</li> <li>• Wash your gloves daily with mild soap and water.</li> <li>• Wash your smock at least weekly with mild soap and water.</li> <li>• Inspect nitrate monthly (even when stored in a frost-free refrigerator).</li> </ul>	<ul style="list-style-type: none"> <li>• Don't continue working with nitrate if you experience any health problems, including breathing, skin, or eye problems. Stop immediately and contact the park safety officer and your doctor.</li> <li>• Don't touch your eyes, hair, or skin with a contaminated gloved hand.</li> <li>• Don't reuse dirty gloves.</li> <li>• Don't wear contact lenses while working with nitrate, as gases may build up under your lenses causing eye injury.</li> </ul>

To Care for Your Nitrate Do This...	Don't Do This...
<p><b>Preparing to Pack Nitrate for Reformatting</b></p> <ul style="list-style-type: none"> <li>• Select your nitrate for duplication. See <i>Conserve O Gram</i> 19/10.</li> <li>• Use highly buffered housing materials with a high calcium carbonate reserve as they can soak up the acidic gases.</li> <li>• Select small shipping boxes and cases, rather than large ones, so that explosive gases can't build up in any quantity.</li> <li>• Document the materials you pack and ship thoroughly by inventorying them and filling out a loan form.</li> <li>• Warn the shipper or courier that nitrate is flammable. Tell them not to leave it in a hot vehicle or smoke near it.</li> <li>• Warn the vendor not to reuse nitrate-contaminated housings and not to place nitrate and duplicates next to each other.</li> <li>• Ensure that the vendor will use a duplication system with a scanning laser or cathode ray tube rather than a quartz iodine bulb enlarger.</li> </ul>	<ul style="list-style-type: none"> <li>• Don't automatically reformat everything.</li> <li>• Don't wait until you are ready to ship the material to begin inventorying, housing, and packing it.</li> <li>• Don't attempt to ship or reformat nitrate that has a flowing (soft and slipping) or powdery image area. Instead deaccession and dispose of these items as hazardous waste.</li> <li>• Don't allow reformatting using a standard modern enlarger with a quartz iodine bulb, as it's too hot.</li> </ul>
<p><b>Dealing with Nitrate After Reformatting</b></p> <ul style="list-style-type: none"> <li>• Determine if copies pass inspection (<i>Conserve O Gram</i> 19/13). If the copies don't pass, reformat them again.</li> <li>• If the copies pass, determine if the nitrate has reached stage 3 deterioration--the emulsion is sticky. If so, dispose of it as hazardous waste after deaccessioning.</li> <li>• If the nitrate is not deteriorated and the copies pass inspection, determine if the nitrate has artifactual, evidential, or associational value (See <i>MH-II</i>, Appendix D). If it has these values, place the nitrate in off-site, well-ventilated cold storage.</li> </ul>	<ul style="list-style-type: none"> <li>• Don't dispose of nitrate automatically after copying it.</li> <li>• Don't place deteriorated nitrate in cold storage.</li> <li>• Don't place nitrate in cold storage permanently without inspecting it monthly for deterioration and arranging to reformat it. Don't put off dealing with a serious problem that will get worse.</li> </ul>

### Shipping Nitrate Film

Don't ship nitrate without knowing its deterioration stage:

**Stage 1.** Stained/Discolored base

**Stage 2.** Sticky base

**Stage 3.** Embrittled base; bubbles form in image layer

**Stage 4.** Base begins to soften, froth, and flow

**Stage 5.** Base turns to brown, acidic powder

**If negatives are in stages 3-5, don't ship the nitrate. Deaccession it and dispose of it as hazardous waste.**

The best method of transporting nitrate is to use the services of a courier in a temperature-

controlled vehicle. The courier must be warned **not** to park the vehicle in the sun for long periods, run the car heater excessively, or smoke, as the heat buildup or sparks from a cigarette might trigger a fire. If a courier is not a practical option, you may use Federal Express to ship nitrate negatives (stills) and UPS to ship motion picture film. Roughly 100 enveloped negatives (1 kg or 2.2 lbs.) or 5 motion picture reels (10 kg or 22 lbs.) can be shipped at a time.

### Packing Photographic Negatives

- Each image should be placed in a buffered (high calcium carbonate reserve) four-fold envelope. Using a four-fold sleeve will protect soft or fragile emulsions from the scraping caused by sliding a negative into a

sleeve. Buffered materials soak up acid fumes. Do not use plastic or unbuffered housings.

- Before placing the negative inside, label each envelope with appropriate captions and control numbers. Labeling first prevents damage to the image.
- Place only about 100 negatives (roughly 2.2 lbs. or 1 kg of nitrate) in a single small box.

### ***Packing Motion Picture Film***

- Place each roll of motion picture film inside a secure perforated film can, preferably relatively new and uncorroded.
- Place the film cans within a small cardboard box. No more than 10 kg (22 lbs.) of nitrate film should be packed in one box.

### ***Packing for Shipping***

- Place the small box of nitrate inside a large cardboard shipping box padded with foam or paper. Don't use standard Federal Express packaging; use packing materials that have no other writing on them.
- Place an extra completed mailing label inside the box.
- Seal the box securely with fiber strapping tape.
- Attach "Flammable Solid" labels to top and sides of the box.

Discuss with the courier or shipping company how the shipping documentation must be prepared. Nitrate film is a dangerous, flammable material and has specific requirements for labeling and transport.

To track the shipment, keep a log documenting all steps involved, including:

- tracking numbers for the nitrate
- dates received by reformatting agency

- dates returned with duplicates
- actions taken to inspect and rehouse the materials
- ultimate disposition of the original nitrate after the duplicates pass inspection

When your copies and nitrate film are returned, follow the steps listed in *Conserve O Gram* 19/13 and in the table above to inspect copies and determine the storage or disposal strategy for your nitrate.

### ***References***

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